Remarks

Addition of Independent Claims 35 and 36

Claims 35 and 36 are added herein to more particularly claim compositions of the instant invention, which are novel and heretofore not known.

Claims 1-7, 9-12, 35 and 36 are pending.

Rejection Pursuant to 35 U.S.C.§102

The Examiner has rejected claims 1-7, 9 and 11-12 as anticipated by Suzuki (U.S. Pat. No. 4,182,824). Namely, the Examiner states that Suzuki teaches silanes "substantially" as claimed.

In response, applicant traverses the rejection and requests reconsideration of all pending claims based on the ensuing remarks.

Applicant's claimed invention, as amended, is directed to a precursor solution for chemical vapor deposition, comprising a hexa-coordinated silicon ß-diketonate and a solvent.

The Examiner relies on Suzuki's disclosures at column 1, lines 42-58; column 3, lines 46-53; and column 4, lines 55-66, for anticipatory purposes (reproduced below) and reasons that "Suzuki teaches a **precursor solution** (emphasis added), wherein the silanes are **prepared** in a hydrocarbon solvent, namely benzene."

> **(c) a silane having the general formula $R^1R^2Si(Q^1CO\text{-}CQ^2\text{-}COQ^3)_2$ wherein R^1, R^2, Q^1, Q^2, Q^3, are selected independently from the group consisting of hydrogen atoms, lower molecular weight alkyl radicals, alkenyl radicals, aryl radicals, alkoxy radicals and the partial hydrolysis products from the alkoxy radicals and;**

> **and**
>
> **The process for producing component (c) is as follows. A dichlorodialkylsilane *RR'SiCl2 is dissolved in benzene*. *Beta-diketo compounds such as acetylacetone or ethyl acetoacetate* are added by dropping them into the mixture and mixing under reflux at 85°-90 °C. The hydrochloric acid by-product is removed by acid acceptors such as triethylamine or pyridine;**
>
> **and**
>
> ***75 g. of methyltrichlorosilane (0.5 mol) and 1,000 ml. of benzene* were placed in a 2 l. flask equipped with a stirrer, reflux condenser and dropping funnel. While the contents were being stirred, 16 g, of methanol (0.5 ml) were added from the dropping funnel.**
>
> **Next, *100 g. (1 mol) of acetylacetone were added* from the dropping funnel. After 10 minutes of stirring, 151.5 g. (1.5 mol) of triethylamine were introduced into the flask.**
>
> **The flask was then heated and refluxed for 2 hours at 80°-90 °C.**

In actuality, Suzuki teaches a process for synthesis of silanes for use in curable organopolysiloxane compositions, which are used as synthetic resins or natural rubbers as indicated by the U.S. Patent Classification Index for Class 528 (See Section [52] of Suzuki patent cover) **NOT** a precursor solution. Suzuki's silane is one of 4 components required in the curable compositions.

Suzuki fails to anticipate applicant's claims, because Suzuki fails to teach a precursor solution, suitable for chemical vapor deposition, comprising a hexa-coordinated, bis beta-diketonate silane and a solvent.

As is well known in the art of CVD, source reagents (precursor solutions), must meet stringent quality control requirements to qualify for use in chemical vapor deposition processes. One specific requirement is that impurity levels not exceed

predefined specifications, as incorporation of same into, for example, a semiconductor device, leads to device failure.

The following excerpt from page 92, Section 3.2, **Handbook of Chemical Vapor Deposition, Second Edition**[1], a copy of which is provided herein in Appendix A, serves to validate applicant's case in point as to the stringent purity requirements for chemical vapor deposition precursor solutions and that which is well known in the applied art.

3.2 Reactant Purity and Contamination

> **The requirement placed on the performance and reliability of CVD coatings are continuously upgraded, For one thing, this means the need for an ever increasing degree of purity of the precursor materials since impurities are the major source of defects in the deposit. The purity of a gas is expressed in terms of nines, for instance, six nines, meaning a gas that is 99.9999% pure, which is now a common requirement. It is also expressed in ppm (parts per million) or ppb (parts per billion) of impurity content.**

What Suzuki enables and places in the public domain is a **reaction mixture** including as components, at least halogenated silane, benzene, beta-diketonate, hydrochloric acid by product, acid acceptor such as pyridine and the salt of the hydrochloric acid and acid acceptor. Subsequent to combining the various components, Suzuki's mixture is refluxed for 2 hours at 80°-90°C, cooled, hydrochloric acid salt of acid acceptor removed by filtration, and benzene and unreacted acid acceptor removed by distillation. (*See* column 3, lines 46-54 and Example 1, Column 4).

Suzuki fails to teach expressly or inherently, a precursor solution suitable for chemical vapor deposition comprising a hexa-coordinated silane and a solvent. Moreover, Suzuki fails to place a precursor solution, useful for chemical vapor deposition of silicon containing gate dielectric thin films in the possession of the public. Still

[1] Pierson, Hugh O. **Handbook of Chemical Vapor Deposition, Second Edition**. **New York: Noyes, 1999.**

further, applicant's claims, in their current form, would not exclude others from making using or selling that, which is taught by Suzuki. Accordingly, Suzuki lacks anticipatory basis for the instant §102 rejection.

Rejection Pursuant to 35 U.S.C.§103

The Examiner has rejected claim 10 under 35 U.S.C.§ 103(a) as being unpatentable over Suzuki (U.S. Patent. No. 4,182,824) in further view of Donly (U.S. Patent No. 4,147,556) namely, because Suzuki teaches the limitations of the claims other than that the solvent is octane, and Donly teaches that benzene and octane are equivalent for the purpose of preparing a solvent solution.

In response, applicant traverses the rejection and requests reconsideration of claim 10, based on the ensuing remarks.

There is **NO** Derivative Basis in Suzuki or Donly, supporting a precursor solution as defined by applicant's claim 10. Amended independent claim 1, upon which claim 10 depends, requires a CVD precursor solution, which includes a hexa-coordinated silicon beta-diketonate composition and octane.

Suzuki teaches a process for synthesis of silanes for use in curable organopolysiloxane compositions, the process including a combining and mixing of at least halogenated silane, benzene, beta-diketonate, hydrochloric acid by product, acid acceptor such as pyridine and the salt of the hydrochloric acid and acid acceptor. Subsequent to combining the various components, Suzuki's mixture is refluxed for 2 hours at 80°-90°C, cooled, hydrochloric acid salt of acid acceptor removed by filtration, and benzene and unreacted acid acceptor removed by distillation. (*See* column 3, lines 46-54 and Example 1, Column 4).

Suzuki does not provide any express, implied, or extrapolative basis for a CVD precursor solution, which includes a hexa-coordinated silicon beta-diketonate composition and octane, as required by applicant's claim 10.

Donly discloses **non-flammable** solvent systems of **metal** beta-diketonates for depositing on float glass. The metal may be any one of, uranium, thorium, erbium, cerium, platinum, antimony, tin, tungsten, titanium, cobalt, iron, chromium, copper, manganese and nickel (*See* column 2, lines 27-30), and the solvent system comprises a solvent for the metal beta-diketonate and a halocarbon or a mixture of halocarbons (*See* column 3, line 66 – column 4 line 3).

Claim 10 of the present application is patentably distinguished over Donly, as Donly specifies metal beta-diketonates dissolved in a two part solvent system, which requires as one part of the system, a halogenated solvent component.

Donly's halogenated solvent is a necessary component in the metal beta-diketonate solutions, as it renders the solution non-flammable. There is no teaching or suggestion in Donly to modify the disclosed mixture solvent systems to remove the halogenated solvent component. Nor is there teaching or suggestion that Donly's two-part solvent system might be useful with beta-diketonate silane compositions.

According to MPEP 2143.01 second paragraph, **"obviousness can only be established by combining or modifying the teachings of the prior art to produce the claimed invention where there is some teaching, suggestion or motivation to do so found either in the references themselves or in the knowledge generally available to one of ordinary skill in the art."**

There is no objective disclosure or derivative basis to modify either the reaction mixture for the silane component of Suzuki's curable organopolysiloxane compositions or Donly's non-flammable solvent systems comprising at least a metal beta-diketonate and a halocarbon solvent, to arrive at a precursor solution for chemical vapor deposition

of silicon containing films, where the precursor solution comprises a hexa-coordinated beta-diketonate-silane component and a solvent component.

Accordingly, the Suzuki and Donly references, either singly or collectively, do not provide any derivative basis for a precursor solution comprising a hexa-coordinated silicon beta-diketonate composition and a solvent component.

The foregoing amendments to the claims as indicated above are sufficient to place all pending claims in condition for allowance. Therefore, removal of rejections pursuant to 35 USC § 102 and 35 USC § 103(a) are respectfully requested.

Petition Under 37 CFR 1.136 for Three Month Extension of Time

Petition hereby is made under the provisions of 37 CFR 1.136 for a two month extension of the term for response to the November 20, 2002 Office Action, extending the term for response to April 20, 2003.

Fees Due and Payable

Amendment of claims herein, includes the addition of two independent claims, bringing the total number of currently pending claims to 13, 5 of which are independent. As applicant had originally paid for 34 claims, of which 4 were independent, a net fee of (1 x $84) $84.00, is due in connection with the addition of one independent claim. Such fee is hereby authorized to be deducted from the Deposit Account No. 50-0860 in the name of applicant, Advanced Technology Materials, Inc., 7 Commerce Drive, Danbury, CT 06810.

Additionally, in connection with applicant's Petition Under 37 CFR 1.136 for Two Month Extension of Time, a fee of $410 as specified in 37 CFR 1.17(a)(2), is hereby authorized to be deducted from the Deposit Account No. 50-0860 in the name of

applicant, Advanced Technology Materials, Inc., 7 Commerce Drive, Danbury, CT 06810.

Should the Office determine any additional fees are due in connection with the entry of this amendment, the Office is hereby authorized to deduct such fee from the above-identified deposit account.

Conclusion

Based on the foregoing, claims 1-7, 9-12, 35 and 36 as amended herein and now pending in the application, embody novel and nonobvious subject matter and such claims now are in form and condition for allowance. Favorable action therefore is requested.

In the event that any issues remain outstanding, incident to the formal allowance of the Application, the Examiner is requested to contact the undersigned agent at (203) 794-1100 ext. 4184 to discuss their resolution, so that this application may be passed to issue at an early date.

Respectfully submitted.

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APPENDIX A

HANDBOOK OF CHEMICAL VAPOR DEPOSTION (CVD)

Principles, Technology, and Applications

Second Edition

by

Hugh O. Pierson

Consultant and Sandia National Laboratories (retired)
Albuquerque, New Mexico

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3.2 Reactant Purity and Contamination

The requirements placed on the performance and reliability of CVD coatings are continuously upgraded. For one thing, this means the need for an ever increasing degree of purity of the precursor materials since impurities are the major source of defects in the deposit. The purity of a gas is expressed in terms of nines, for instance, six nines, meaning a gas that is 99.9999% pure, which is now a common requirement. It is also expressed in ppm (parts per million) or ppb (parts per billion) of impurity content.

Suppliers of precursor materials are well aware of this problem and are making considerable efforts to improve their products, usually at a greatly increased cost. However, using a pure reactant is not sufficient since a gas can become contaminated again as it leaves its storage container and travels through the distribution system to the reactor chamber. It can pick up moisture, oxygen, particles, and other contaminants even if gas-tight metal lines are used. For that reason, it is often recommended to purify and filter the gases at the point of use, i.e., just before entering the reaction zone.[8]–[10]

There are several methods used to purify gases: catalytic adsorption, palladium diffusion, gettering, chemisorption, and filtration.[11]

Catalytic Adsorption. This method can reduce impurities, such as H_2, O_2, CO, and hydrocarbons, to less than 10 ppb. The catalyst converts these impurities into CO_2, H_2O, and other species that can then be removed by molecular sieves and cryogenic adsorption.

Palladium Diffusion. Palladium is very permeable to hydrogen but not permeable to other gases. As a result, it is a useful hydrogen purifier. A palladium membrane, heated to 400°C, purifies hydrogen to <10 ppb but requires a high pressure differential for net diffusion to take place at reasonable rates of hydrogen supply.

Gettering. Gettering materials, such as zirconium or titanium alloys, are heated to 400°C. At that temperature, they react with the impurities in the gas stream such as O_2, H_2O, N_2, H_2, CO, CO_2, and hydrocarbons. Total impurities can be reduced to <100 ppb.